



First records of *Sepedonea lindneri* (Hendel, 1932) and *Protodictya lilloana* Steyskal, 1953 (Diptera, Sciomyzidae) from Uruguay with an overview on their biology

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Abstract

Sciomyzidae (Diptera) has been recorded in several countries of South America, but few species have been found in Uruguay. We report the first record of *Sepedonea lindneri* (Hendel, 1932) and *Protodictya lilloana* Steyskal, 1953 (Diptera, Sciomyzidae) from Uruguay. The specimens were collected in rice crops and in adjacent native vegetation with sweep net and vacuum sampler from December to March (2012–2015) in the Eastern region of the country. Photos of collection areas, habitus of adults and distribution map of the species are provided.

Key words

Apple snail control, geographic distribution, marsh flies, Neotropical Region, rice crop.

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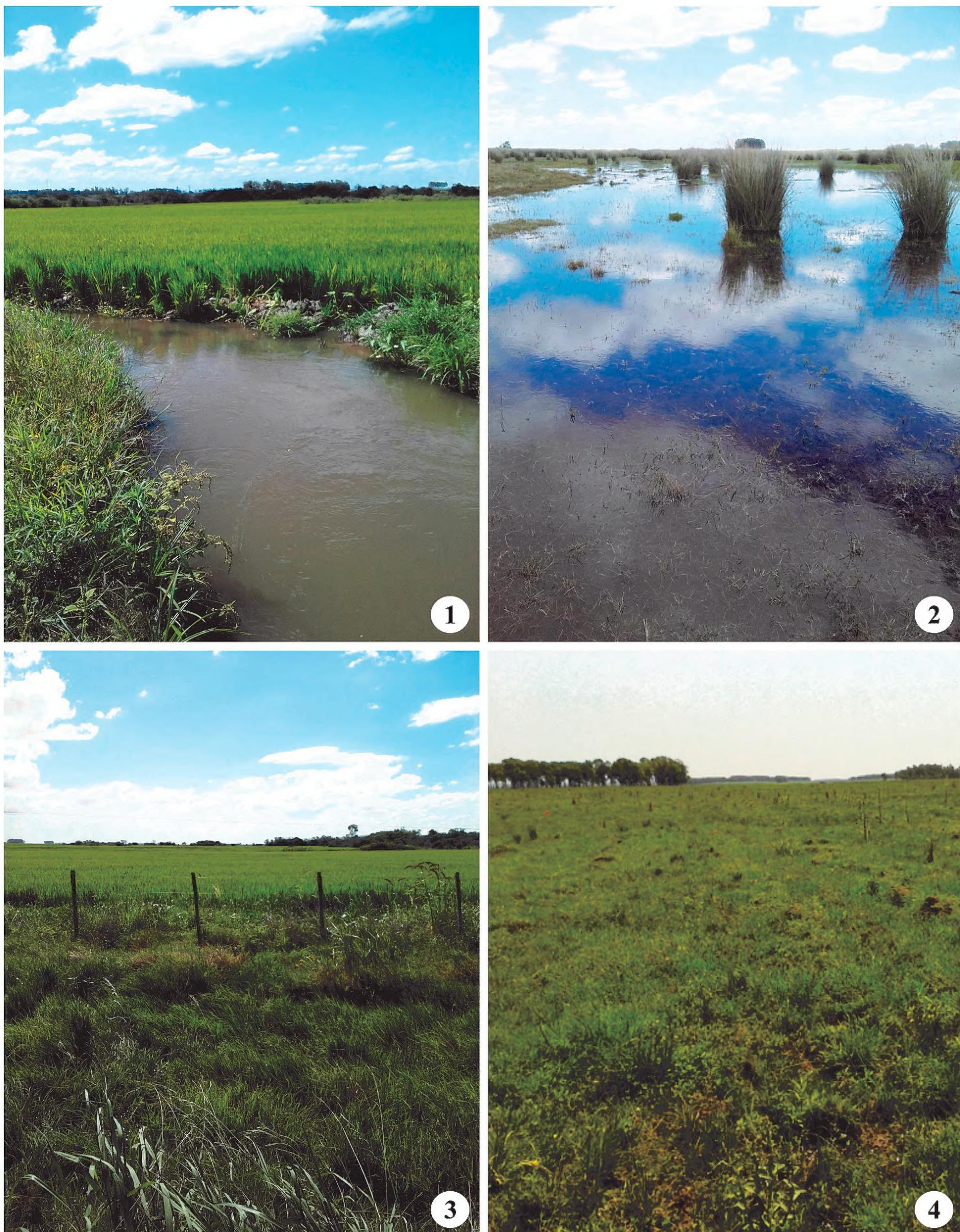
Introduction

The Sciomyzidae (Diptera) are commonly known as marsh flies or snail-killing flies. They are the only family formed almost exclusively by obligate killers of mollusks (Marinoni and Knutson 2010, Chapman et al. 2012). Within the Diptera, Sciomyzidae is the family of greatest relevance as biocontrol agent of gastropods (Gormally 1988, Maharaj et al. 1992, Barker et al. 2004, Marinoni and Knutson 2010, Kirst et al. 2015).

Species of this family are small to moderately large and range from 1.8 to 11.5 mm in length. Their color

varies from shiny black to dull gray, brown, yellowish or reddish. Wings are often patterned. Legs are often elongated and antennae elongated and prorrect (Knutson 1987b). Sciomyzid flies are recognized by the absence of oral vibrissae, postocellar setae parallel or slightly diverging, costa entire, subcostal complete, one or more tibia with preapical setae (Barker et al. 2004).

The family Sciomyzidae comprises more than 600 species in approximately 63 genera distributed worldwide, with a higher diversity recorded from temperate regions (Vala et al. 2012, 2013, Marinoni and Mathis 2006, Marinoni and Murphy 2016). In the Neotropical



Figures 1–4. Environments of collection of Sciomyzidae. **1.** River near rice crop. **2.** Temporary pond with aquatic plants. **3.** Native vegetation in the border of rice crop **4.** Pasture.

Region, the number of taxa described is 103 species in 25 genera (Berg and Knutson 1978, Knutson 1987a, b, Marinoni and Mathis 2000, Marinoni and Murphy 2016). The fauna of Sciomyzidae from Uruguay is poorly known. The only report corresponds to that by Marinoni and Murphy (2016) who reported *Perilimnia albifacies*

Becker, 1919 and *Sepedomerus bipuncticeps* (Malloch, 1933) from Montevideo. Since then, additional species were not described or recorded for this country. The aim of this study was assessing the arthropod diversity associated to rice crop.

We report *Sepedonea lindneri* (Hendel, 1932) and

Protodictya lilloana Steyskal, 1953 for the first time in Uruguay. New studies and surveys will undoubtedly increase the number of sciomyzid species known for this country.

Methods

This study was conducted in the Treinta y Tres province, Eastern region of Uruguay, from December 2012 to November 2015. The adult sciomyzids were collected with a sweep net and vacuum sampler during a biodiversity project carried out on rice agroecosystem in 4 localities: Julio María Sanz ($33^{\circ}11'54.99''$ S, $054^{\circ}05'12.30''$ W), El Tigre ($33^{\circ}13'27.80''$ S, $053^{\circ}59'38.84''$ W), General Enrique Martínez ($33^{\circ}12'08.15''$ S, $53^{\circ}50'47.98''$ W) and Paso de la Laguna ($33^{\circ}16'27.07''$ S, $054^{\circ}09'53.52''$ W) (Fig. 12).

The Eastern region of Uruguay is one of the most important cultivated areas (ACA 2013). It is located within the Bañados del Este, a wetland area that belongs to an international protected area by the RAMSAR convention (PROBIDES 1999). Different aquatic environments were sampled. Collecting was done near a small river bordering the rice crops (Fig. 1). Also, natural areas with temporary ponds and aquatic plants formed during the rainy season (Fig. 2) were sampled, as well as disturbed margins and surroundings with the vegetation altered, such as pastures (Figs 3, 4). Rice crop and native vegetation surroundings (NV: riparian forest patches) were also sampled. Collections with an aerial net were made by vegetation sweeping. The net was used along the crop, doing 8 transects of 20 sweeps by location. Vacuum sampler was used to aspirate at 15 points, for 60 seconds in each location.

Collected flies were placed into plastic vials with 70% ethyl alcohol and taken to the Entomology Laboratory of Facultad de Agronomía (Montevideo) where they were prepared for identification. The adults were identified following the taxonomic keys by Steyskal and Knutson (1975), Freidberg et al. (1991), Marinoni and Knutson (1992), Marinoni and Mathis (2006). Voucher

specimens were deposited at the Entomological Collection of Facultad de Agronomía, Universidad de la República (Unidad de Entomología, Montevideo, Uruguay) and Entomological Collection, “Padre Jesus Santiago Moure,” Department of Zoology, Universidade Federal do Paraná (DZUP).

The habitus illustrations are digital photographs taken from a lateral view with a stereoscopic microscope Konus Crystal 45 with a Dino-Eye Microscope Eyepiece Camera, enhanced using Photoshop CS6 to adjust the color and make minor corrections (e.g. remove debris).

Distribution maps were made using Quantum GIS 2.8. Longitude and latitude were obtained for each locality where specimens were collected using a GPS GARMIN Etrex and were entered into a Microsoft Excel spreadsheet. Localities of specimens were plotted on a world land projection, presented within ESRI ArcView layouts, and exported as encapsulated postscript (EPS) files.

Results

A total of 28 specimens of marsh-flies belonging to the genera *Sepedonea* Steyskal and *Protodictya* Malloch were collected and identified. *Sepedonea lindneri* (Hendel, 1932) and *Protodictya lilloana* Steyskal, 1953 are reported for the first time for Uruguay (Table 1).

Sepedonea lindneri (Hendel, 1932)

Figures 5–8

New records. Uruguay: Treinta y Tres, Paso de la Laguna ($33^{\circ}16'27.07''$ S, $054^{\circ}09'53.52''$ W, 1-II-2013, 6-III-2013, 14-XI-2013) Leticia Bao y Luis Casales (11 specimens). El Tigre ($33^{\circ}14'47.58''$ S, $054^{\circ}05'27.86''$ W, 23-I-2013, 14-XI-2013, 26-XII-2013) Leticia Bao, Luis Casales y María Caraballo (7 specimens). *S. lindneri* was collected mainly in rice crops, but 3 specimens were collected in adjacent native vegetation patches (Table 1).

Protodictya lilloana Steyskal, 1953

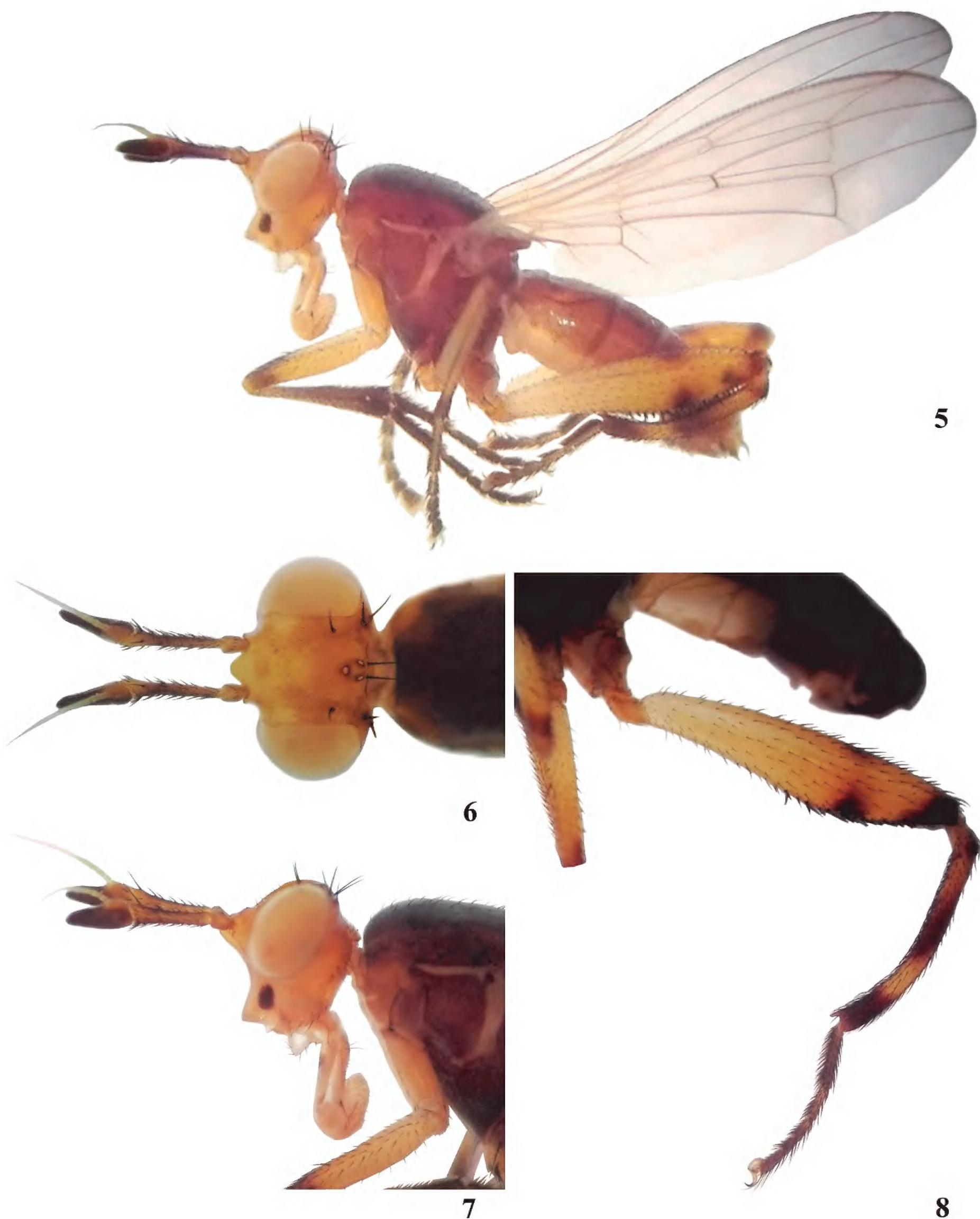
Figures 9–11

New records. Uruguay: Treinta y Tres, El Tigre ($33^{\circ}14'47.58''$ S, $054^{\circ}05'27.86''$ W, 19-XII-2012) Leticia Bao

Table 1. Sciomyzid species and collecting data. Abbreviations: *N* = number of specimens collected, NV = native vegetation patches adjacent to rice crop.

Species	N	Date	Locality	Landscape / N	Sampling method	Collectors*
<i>Sepedonea lindneri</i> (Hendel, 1932)	11	1-II-2013 6-III-2013 14-XI-2013	Paso de la Laguna	Rice (11)	Sweep net	LB, LC
	7	23-I-2013 14-XI-2013 26-XII-2013	El Tigre	Rice (4), NV (3)	Vacuum sampler/sweep net	LB, LC, MC
<i>Protodictya lilloana</i> Steyskal 1953	4	14-XI-2013 28-XI-2013	Julio María Sanz	Rice (4)	Vacuum sampler	LB, LC
	1	19-XII-2012	El Tigre	Rice (1)	Sweep net	LB, LC
	5	14-XI-2013 17-III-2014 13-X-2013	General Enrique Martínez	Rice (2), NV (2), Pasture (1)	Vacuum sampler	LB, LC, MC

*Abbreviated names: LB = Leticia Bao, LC = Luis Casales, MC = María Caraballo.



Figures 5–8. *Sepedonea lindneri* (Hendel, 1932). **5.** Habitus, lateral view. **6.** Head, dorsal. **7.** Head, lateral. **8.** Hind leg, lateral.

y Luis Casales (1 specimen). General Enrique Martínez (33°12'8.15" S, 53°50'47.98" W, 14-XI-2013, 17-III-2014, 13-X-2014) Leticia Bao, Luis Casales y María Caraballo (5 specimens). Julio María Sanz (33°11'54.99" S, 054°05'12.30" W, 14-XI-2013, 28-XI-2013) Leticia Bao y Luis Casales (4 specimens). *P. lilloana* was mainly found in rice crop, with 2 specimens collected in adjacent native vegetation patches and 1 specimen collected on pasture (Table 1).

Identification. According to Freidberg et al. (1991), adults of *S. lindneri* are usually yellow to dark brown, with a lateral facial spot on the head (Fig. 7). Postocellar setae well developed and ocellar seta absent (Fig. 6). The mesonotum is usually grayish black (Figs 5, 6). Mid femur postero-ventrally with 4–7 spines. Hind femur with dark lateral and rounded dorsal preapical spots (Fig. 8). Wings are grayish hyaline, with indistinct clouds on crossveins r-m and dm-cu (Fig. 5). This species has the southernmost



Figures 9–11. *Protodictya lilloana* Steyskal 1953. **9.** Habitus, lateral view. **10.** Head, dorsal. **11.** Head, lateral.

distribution of all congeners and can be differentiated from other species of the genus using the key in Freidberg et al. (1991). *Protodictya lilloana* can be identified using the key in Marinoni and Knutson (1992). Adults are dark brown with a frontal facial black spot in the anterior half (Figs 10, 11). The antenna with third antennomere apically darkened bearing a plumose arista. Wings have apical hyaline spots in cells r_{2+3} and r_{4+5} aligned (Fig. 9).

Discussion

Sepedonea and *Protodictya* are widely distributed in the Neotropical Region, mainly in Brazil (Marinoni and Knutson 2010). *Sepedonea* with 13 species and *Protodictya* with 8 species are within the richest sciomyzid genera in neotropical areas (Marinoni and Knutson 2010, Kirst et al. 2015). However, few species of Sciomyzidae

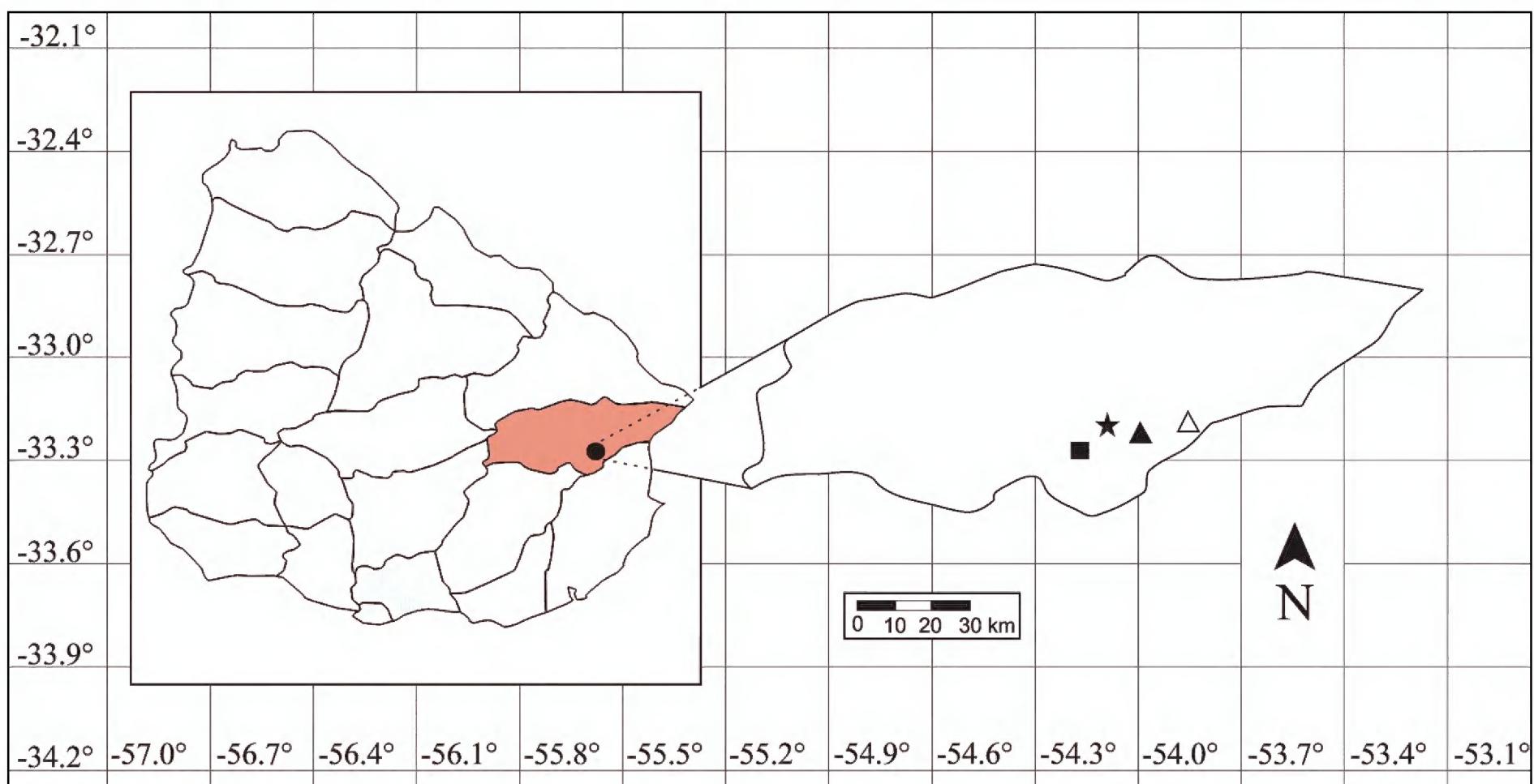


Figure 12. New records of the Sciomyzidae species from Treinta y Tres province, Uruguay: Δ = General Enrique Martínez, \blacktriangle = El Tigre, \star = Julio María Sanz, \blacksquare = Paso de la Laguna.

have been recorded in Uruguay (*Perilimnia albifacies* and *Sepedomerus bipuncticeps*) (Marinoni and Murphy 2016), and knowledge on species is still scarce. In this work, we expanded the distributions of *Sepedonea lindneri* and *Protodictya lilloana* to Uruguay. These species are present in the Pampean Region (Pires and Marinoni 2010, Kirst et al. 2015), but at the moment have not been reported from Uruguay.

Both species are predators of non-operculate snails in different freshwater situations and are strictly neotropical (Knutson and Valley 1978, Freidberg et al. 1991, Marinoni personal communication). These species belong to the same eco-group defined by Barker et al. (2004), the group that inhabits in benthic freshwater, estuarine littoral habitats and in wetlands to dry land habitats. Oviposition takes place on prey or habitat substrates, and first instar larvae feeding behavior ranges from saprophagous scavenger, to polyphagous predator or parasitoid, or oligophagous parasitoid.

Considering the potential hosts present in the habitats surveyed, it is worth mentioning the golden apple snail *Pomacea canaliculata* (Lamarck, 1822) (Gastropoda, Ampullariidae) as a species commonly found in Uruguay (Hayes et al. 2012). *Pomacea canaliculata* became a rice pest in the Asiatic continent after its introduction as human food or exotic snails in aquarists' shops (Joshi 2005, Murphy et al. 2012). *Pomacea canaliculata* is prey of certain sciomyzid larvae in the Nearctic Region in freshwater habitats (Foote et al. 1999).

The species *S. lindneri* and *P. lilloana* recorded for Uruguay in this work, can play an important role in the biological control of this snail pest in rice crops in Uruguay. Given the type of habitat and host/prey required by sciomyzids and the rice cultivation under flooding, the crop could be considered as a biological corridor for

these species. Both species are closely associated with semi-aquatic environments where they develop and find their hosts. More research should be conducted with the aim of knowing the host snail species that the 2 sciomyzid species reported here have the potential to control, considering that *P. canaliculata* is not a pest at present in Uruguay but causes severe damages in invaded Asiatic fields (Joshi 2005, Murphy et al. 2012).

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Author's Contributions

The paper was originally conceived by LB and LM. Study was designed by LB and EC. LB, SM carried out the fieldwork. LB processed collected material, LM and MS identified the exemplars and performed the curatorial work. LB analyzed the data. MS made the distribution map. All authors wrote the final version of the manuscript.

References

ACA (2013) Guía de buenas prácticas en el cultivo de arroz en Uruguay. http://www.aca.com.uy/wp-content/uploads/2014/07/GUIA_DE_BUENAS_PRACTICAS_marzo_2013.pdf Accessed on: 2018-07-05.

Barker G, Knutson L, Vala JC, Coupland JB, Barnes J (2004) Overview of the biology of marsh flies (Diptera: Sciomyzidae), with special reference to predators and parasitoids of terrestrial gastropods. In: Barker GM (Ed) *Natural Enemies of Terrestrial Molluscs*. Wallingford, CABI Publishing, 159–225.

Berg CO, Knutson LV (1978) Biology and systematics of the Sciomyzidae. *Annual Review Entomology* 23: 239–258. <https://doi.org/10.1146/annurev.en.23.010178.001323>

Chapman EG, Przhiboro AA, Harwood JD, Foote BA, Hoeh WR (2012) Widespread and persistent invasions of terrestrial habitats coincident with larval feeding behavior transitions during snail-killing fly evolution (Diptera: Sciomyzidae). *BMC Evolutionary Biology* 12: 1–22. <https://doi.org/10.1186/1471-2148-12-175>

Foote BA, Knutson LV, Keiper JB (1999) The snail-killing flies of Alaska (Diptera: Sciomyzidae). *Insecta Mundi* 13: 45–71.

Freidberg A, Knutson L, Abercrombie J (1991) A revision of *Sepedonea*, a neotropical genus of snail-killing flies (Diptera: Sciomyzidae). *Smithsonian Contributions to Zoology* 506: 1–48. <https://doi.org/10.5479/si.00810282.506>

Gormally MJ (1988) Studies on the oviposition and longevity of *Llione albisetosa* (Dipt.: Sciomyzidae) potential biological control agent of liver fluke. *Entomophaga* 33: 387–395.

Hayes KA, Cowie RH, Thiengo SC, Strong EE (2012) Comparing apples with apples: clarifying the identities of two highly invasive Neotropical Ampullariidae (Caenogastropoda). *Zoological Journal of the Linnean Society* 166: 723–753.

Joshi RC (2005) Managing invasive alien species in rice. *International Rice Research Institute Notes* 30: 5–13.

Kirst FD, Marinoni L, Krüger RF (2015) New distribution records for Sciomyzidae species (Insecta, Diptera) from Rio Grande do Sul, Brazil. *Check List* 11: 1552. <https://doi.org/10.15560/11.1.1552>

Knutson LV (1987a) Life cycles of snail-killing flies: *Pherbellia griseicollis*, *Sciomyza dryomyzina*, *S. simplex*, and *S. testacea* (Diptera: Sciomyzidae). *Insect Systematics & Evolution* 18 (4): 383–391. <https://doi.org/10.1163/187631287X00197>

Knutson LV (1987b) Sciomyzidae. In: McAlpine JF (Ed.) *Manual of Nearctic Diptera* 2. Biosystematics Research Centre, Ottawa, 927–940.

Knutson LV, Valley K (1978) Biology of a neotropical snail-killing fly, *Sepedonea isthmi* (Diptera: Sciomyzidae). *Proceedings of the Entomological Society of Washington* 80 (2): 197–209.

Maharaj R, Appleton CC, Miller RM (1992) Snail predation by larvae of *Sepedon scapularis* Adams (Diptera: Sciomyzidae), a potential biocontrol agent of snail intermediate hosts of schistosomiasis in South Africa. *Medical and Veterinary Entomology* 6: 183–187.

Marinoni L, Knutson LV (1992) Revisão do gênero neotropical *Protodictya* Malloch, 1933 (Diptera, Sciomyzidae). *Revista Brasileira de Entomologia* 36 (2): 25–45.

Marinoni L, Knutson LV (2010) Sciomyzidae. In: Brown BV, Borkent A, Cumming JM, Wood DM, Woodley NE, Zumbado MA (Eds) *Manual of Central American Diptera*. Vol. 2. NRC Research Press, Ottawa, 1017–1024.

Marinoni L, Mathis WN (2000) A cladistic analysis of Sciomyzidae Fallén (Diptera). *Proceedings of Biological Society of Washington* 113: 162–209.

Marinoni L, Mathis WN (2006) A cladistic analysis of the Neotropical genus *Sepedonea* Steyskal (Diptera: Sciomyzidae). *Zootaxa* 1236: 37–52.

Marinoni L, Murphy WL (2016) Family Sciomyzidae. In: Wolff M, Nihei SS, Carvalho CJB (Eds) *Catalogue of Diptera of Colombia*. *Zootaxa* 4122 (1): 642–647. <https://doi.org/10.11646/zootaxa.4122.1.3>

Murphy WL, Knutson LV, Chapman EG, Mc Donnell RG, Williams CD, Foote BA, Vala JC (2012) Key aspects of the biology of snail-killing Sciomyzidae Flies. *Annual Review of Entomology* 57: 425–47. <https://doi.org/10.1146/annurev-ento-120710-100702>

Pires AC, Marinoni L (2010) Historical relationships among Neotropical endemic areas based on *Sepedonea* (Diptera: Sciomyzidae) phylogenetic and distribution data. *Zoologia* 27 (5): 681–690. <https://doi.org/10.1590/S1984-46702010000500003>

PROBIDES (1999) *Plan Director. Reserva de Biosfera Bañados del Este, Uruguay*. PROBIDES, Rocha, Uruguay, 159 pp.

Steyskal GC, Knutson LV (1975) Key to the genera of Sciomyzidae (Diptera) from the Americas South of the United States, with descriptions of two new genera. *Proceedings of the Entomological Society of Washington* 77 (3): 274–277.

Vala JC, Murphy WL, Knutson LV, Rozkošný R (2012) A cornucopia for Sciomyzidae (Diptera). *Studia Dipterologica* 19 (1–2): 67–137.

Vala JC, Murphy WL, Knutson LV, Rozkošný R (2013) Corrigenda for the publication “A cornucopia for Sciomyzidae (Diptera).” *Studia Dipterologica* 20 (2): 183–188.